Fuel Efficiency Improvement Through The Use Of An Acetylene-powered Engine

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Abstract

Studies reveal that Acetylene gas produced from limestone (CaCO3) is renewable and exhibits Similar properties to those of hydrogen. An experimental investigation has been carried out on a Single cylinder, direct injection (DI), and Spark ignition (SI) engine tested with pure petrol and petrol - Acetylene dual fuel mode with diethyl ether (DEE) as an oxygenated additive. Experiments were conducted to study the performance characteristics of DI petrol engines in dual fuel mode by aspirating Acetylene gas in the inlet manifold, with petrol-diethyl ether blends (DEE) as an ignition source. A fixed quantity of Acetylene gas was aspirated and a Blend of diethyl ether with petrol (DEE10, DEE20and DEE30) was taken and then readings were taken at various loads. From the detailed study, it has been concluded that the blending ratio of DEE20 gives better performance. Dual fuel operation along with the addition of diethyl ether resulted in higher thermal efficiency when compared to neat petrol operation. Acetylene aspiration reduces smoke and exhaust temperature.

Keywords: Efficiency, Acetylene, Gas, Limestone

1. INTRODUCTION

In the present context, the world is confronted with the twin crisis of fossil fuel depletion and environmental degradation. Conventional hydrocarbon fuels used by internal combustion engines, which continue to dominate many fields like transportation, agriculture, and power generation lead to pollutants like HC (hydrocarbons), SOX (Sulphur oxides), and particulates which are highly harmful to human health. CO2 from Greenhouse gas increases global warming. This crisis has stimulated active research interest in non-petroleum, a renewable and non-polluting fuel, which has promised a harmonious correlation with sustainable development, energy conservation, efficiency, and environmental preservation. Promising alternate fuels for internal combustion engines are natural gas, liquefied petroleum gas (LPG), hydrogen, acetylene, producer gas, alcohol, and vegetable oils. Among these fuels, there has been a considerable effort in the world to develop and introduce alternative gaseous fuels to replace conventional fuels with partial replacement or total replacement. Many of the gaseous fuels can be obtained from renewable sources. They have a high self-ignition temperature and hence are

excellent spark ignition engine fuels. They cannot be used directly in petrol engines However, Petrol engines can be made to use a considerable amount of gaseous fuels in dual fuel mode without incorporating any major changes in engine construction. It is possible to trace the origin of the dual fuel engines to Rudolf Petrol, who patented an engine running on essentially the dual-fuel principle. Here gaseous fuel called primary fuel is either inducted along with air intake, or injected directly into the cylinder and compressed, but does not auto-ignite due to its very high self-ignition temperature. Ignition of a homogeneous mixture of air and gas is achieved by timed injection of a small quantity of petrol called pilot fuel near the end of the compression stroke. The pilot petrol fuel auto-ignites first and acts as a deliberate source of ignition for the primary fuel-air mixture. The combustion of gaseous fuel occurs by flame propagation Similar to SI engine combustion. Thus dual fuel engine combines the features of both SI and SI engines in a complex manner. The dual fuel mode of operation leads to smoother operation; lower smoke emission and thermal efficiency are almost comparable to the petrol version at medium and high loads. However, the major drawback with these engines is higher NOx emissions, poor part load performance, and higher ignition delay with certain gases like biogas and rough engine operation near full load due to the high rate of combustion.

2. MATERIALS AND METHODS

2.1 PREPARATION OF ACETYLENE

15g of calcium carbide are placed in a 150 ml distilling flask. A dropping funnel and a glass tube are fitted to the top of the flask. The glass tube is connected to a wash bottle containing 10% aqueous copper sulfate solution. The tall dropping funnel is required to give a sufficient “head” of water in the funnel to force the acetylene to pass through the wash bottle. Additionally, a delivery tube is fitted to the wash bottle, which is used for collecting acetylene under water or delivering the gas for the required experiment.

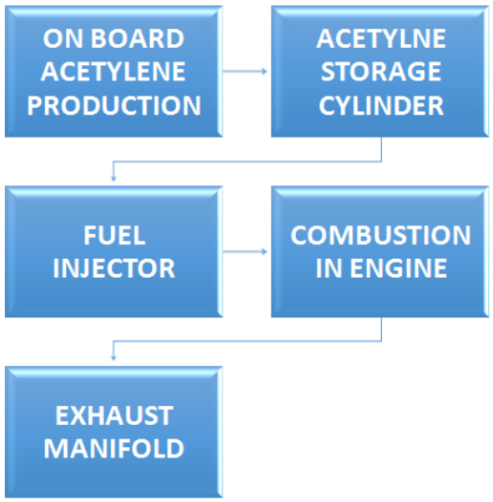
$$CaCO_3 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)$$

The dropping funnel is filled with water and added to the flask drop-wise. By contacting with calcium carbide acetylene is at once generated, and on passing through the copper sulfate solution is freed from hydrogen sulfate or other impurities. At the beginning of the experiment, the acetylene passes through the apparatus until all the air is expelled. The acetylene is collected under water or directly used for an experiment.

2.2 PHYSICAL PROPERTIES OF ACETYLENE

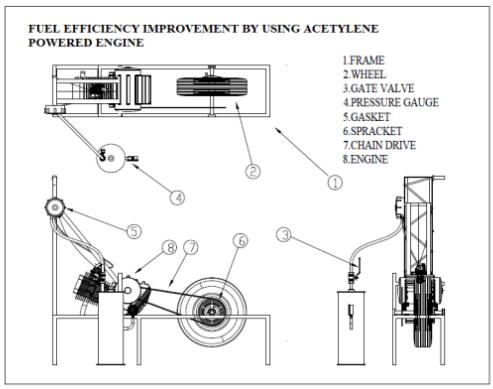
Formula	C2H2
Molecular Weight (lb/mol)	26.04
Critical Temp. (°F)	96.0
Critical Pressure (psia)	906.0
Boiling Point (°F)	-119.6
Melting Point (°F)	-113.4
Psat @ 70°F (psia)	586.2
Liquid Density @ 70°F (lb/ft3)	23.61
Gas Density @ 70°F 1 atm (lb/ft3)	0.0677
Specific Volume @ 70°F 1 atm (ft3/lb)	14.76
Specific Gravity	0.920
Specific Heat @ 70°F (Btu/lbmol-°F)	10.53

2.3 WORKING METHOD



3. RESULTS AND DISCUSSION

3.1 EXPERIMENTAL SETUP



3.2 DISCUSSION AND WORKING

Calcium carbide is a chemical compound with the chemical formula of CaC2. Its main use industrially is in the production of acetylene. Acetylene is also produced by reacting Calcium carbide (CaC2) with water with the help of cathode and anode terminals. The 12-volt battery supply is given to these electrodes so that the Acetylene comes out from the negative terminal tank. This output gas is dipped into the multi-tank so that Acetylene is produced. This will be explained in the above chapter. Here's some information on a simple homegrown method for producing pure Acetylene and petrol gas. The beauty of this system is that it uses a common inexpensive chemical that is not consumed in the reaction, so it can be used again and again almost indefinitely (if you use pure multi in the reaction). The output fuel is used to run the engine. Until recently it has not been practical to use acetylene for gas engines, because very few acetylene generators generate acetylene at a temperature low enough to obtain a purity of gas or quantity sufficient to bring about the practical use of acetylene in an engine, but there are some generators producing acetylene of a sufficiently low degree of temperature to bring about a purity of quality and increase of volume of acetylene to such an extent that cooking and heating with acetylene has not only been made practical and profitable to many who are now using acetylene but its use is now applied very practically to engines, which have been formerly used with gas and gasoline. "Of course, engines used for this purpose are specially constructed, because a much smaller quantity of acetylene is required, when properly mixed with oxygen, to bring about good results in an engine that is used when coal gas is applied. An engine of this kind may be applied for running various kinds of machinery for factory purposes and the generator is used for furnishing acetylene for heat, light, and power. The heat may be used in the laboratory, the light for illuminating the entire premises, acetylene as applied to the engine, and power for the entire institution - all supplied from one source. The advent of the acetylene engine in the field of active industry will be a great boon to the trade generally since in many places acetylene generators will be purchased strictly for the sake of obtaining the gas for power purposes. "A country home or estate may now be fitted out with an acetylene plant, whereby the lighting of the buildings, as well as the grounds, is supplied from the machine, acetylene for heating and cooking purposes in the culinary department, and hot water heating appliances in the bathroom. The acetylene engine can be used to force water through pipes in the most modern manner possible to conceive of, thus supplying the suburbanite with all the luxuries of city life so far as these particular items are concerned. "It is very interesting indeed to know the various uses to which acetylene is being applied. There is hardly a day at present but some new application is made of this valuable combination of carbon and hydrogen. e see it in use on all up-to-date automobiles, launches, bicycles, and many other similar uses, where the very brightest and best results are desired by way of illumination. ow, since the acetylene engine has come into the field, it would not be at all surprising to see within the next year at the automobile show, an automobile propelled as well as illuminated with acetylene.

3.3 FUEL EFFICIENCY TEST RESULT ACETYLENE

ACETYLENE (gram)	PETROL (ml)	PRESSURE (acetylene)	RUNNING TIME (acetylene)	RUNNING TIME (petrol)
50	50	1.5bar	8min	5.45min
100	100	3bar	15.7min	10.9min
150	150	4.5bar	23.8min	16.35min
200	200	6bar	31.5min	21.8min
250	250	7.5bar	40.5min	27.25min
300	300	9bar	47.35min	32.7min

3.4 PROJECT PROGRESS

4. CONCLUSIONS

Experiments were conducted to study the performance and emission characteristics of SI petrol engines in dual fuel mode of operation by aspirating acetylene gas in the inlet manifold for various loads, with petrol as an ignition source. The following conclusions have been arrived at, based on the experimental results: • Brake thermal efficiency in dual fuel mode is lower than petrol operation at full load, as a result of continuous induction of acetylene in the intake. There is an increase in the peak cylinder pressure and rate of pressure rise when gas is inducted. On the whole, it is concluded that acetylene induction resulted in a slight decrease in thermal efficiency when compared to baseline petrol operation. As acetylene has a wide range of merits on environmental as well as economic grounds. It produces only carbon dioxide during combustion and is less costly than conventional fuel as acetylene is produced from calcium carbonate which is in abundance. Acetylene has proved to be better fuel due to its non-polluting nature and more economic.

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